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Merchantable Volume Table for Ucar in Puerto Rico

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SUMMARY

Ucar (*Bucida buceras* L.) is a timber tree of the dry forests of islands in and lands surrounding the Caribbean. The wood is attractive and strong but very heavy and hard. Little information and no volume tables were available for the species, however. Fifty trees from forests in Puerto Rico were measured for d.b.h., merchantable height, and diameter and bark thickness at 1-m intervals on the bole. Equations for inside and outside bark merchantable volumes were developed and are presented in equation and tabular form.

INTRODUCTION

Ucar (*Bucida buceras* L.), also known as black olive, is a common timber tree of dry forests throughout the Caribbean, Central America, and northern South America (Little and Wadsworth 1964). Horticultural selections are now commonly planted as shade trees.

The wood of ucar is very heavy (specific gravity 0.93 g/cm^3), hard, and strong and has a greenish-brown color. It has an attractive grain and polishes to a high sheen. The wood finds its best use as flooring, but is also useful for railroad ties, posts, timbers, nonmarlne piling, and charcoal (Longwood 1961). Notwithstanding its beauty, the use of ucar for furniture and artisanry has been limited because of its extreme hardness.

Considerable volumes of ucar grow across the natural range. The logs are generally short but may be thick (Longwood 1961). Very little has been written about the growth and management of ucar. Until now, no volume tables have been constructed.

METHODS

The sample trees for this study were selected from natural stands across the range of ucar in Puerto Rico. Fifty trees were chosen, giving a range of sizes from 20 cm in d.b.h. (diameter at breast height) upward and commercial bole lengths of 2 m and longer. Diameters were measured with a diameter tape. Commercial bole length was defined as the distance between the top of the stump (just above the flared root collor) and the point at which the bole would be topped by a commercial logger. This upper point is somewhat subjective, but almost always occurs in ucar just below a major ramification, rarely at a 15-cm minimum top diameter. Each tree was measured for stump height, stump diameter, and diameters at l-m intervals up the bole until commercial height was reached. Bark thickness was determined with a bark gauge at each 1 -meter interval. Most of the diameter measurements were made by a person using a ladder strapped to the tree bole. For those portions of a few merchantable boles above 8 m, diameters were measured with a pentaprism at points located with an altimeter.

Sample tree volumes were summed from l-m sections using Smalian's formula (Avery 1967). Allometric models for outside- and inside-bark cubic volumes (in m^3) based on d.b.h. and commercial bole length were fitted by taking the natural logarithm of the allometric model and fitting to the data using simple linear regression techniques (Schlaegel 1981). A model for inside-bark diameter was fitted using a polynomial model with bole diameter as the independent variable.

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RESULTS

The following are allometric equations for merchantable volume outside bark and volume inside bark:

$$Vob = 0.0019818\ D^{1.85328}\ L^{0.88674}$$
$$n = 50$$
$$Sy.x = 0.0794$$
$$FI = 99.3 \text{ percent}$$

$$Vib = 0.00014332\ D^{1.91345}\ L^{0.86076}$$
$$n = 50$$
$$Sy.x = 0.0854$$
$$FI = 99.3 \text{ percent}$$

where:

Vob = green volume outside bark (m^3)
Vib = green volume inside bark (m^3)
D = d.b.h. (nearest 0.1 cm)
L = commercial bole length (nearest 0.1 m)
sy.x = root mean square error ($lognm^3$)
FI = fit index (analogous to R^2, Schlaegel 1981)

Using these models, volumes for the d.b.h.'s and commercial bole lengths that might be encountered were calculated and are presented in table 1. Likewise, inside bark volumes were calculated and are presented in table 2. Inside bark diameter can be predicted by the following equation.

$$Dib = -0.04109 + 0.92758\ Dob + 0.000368\ Dob^2$$
$$n = 138$$
$$Sy.x = 0.7540$$
$$R^2 = 99.9 \text{ percent}$$

where:

Dib = diameter inside bark (nearest 0.1 cm)
Dob = bole diameter outside bark (nearest 0.1 cm)
R^2 = coefficient of determination

Residuals were plotted, and no apparent trends were noted. The bark was consistently thinner near the base of the trees than higher up. This undoubtedly contributes to the sensitivity of ucar to fire. Stump heights varied with degree of butt swell and other irregulariiies. Stump heights of the sample trees averaged 0.34 ± 0.03 m.

Table 1.— *Cubic-meter merchantable stem volume (outside bark) of ucar*

D.b.h.	Merchantable bole length (m)														
	2	3	4	5	6	7	6	9	10	11	12	13	14	15	16
cm	Cubic meters*														
20	0.08	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.28	0.30	0.31	0.33	0.34
25	0.12	0.16	0.20	0.23	0.26	0.29	0.32	0.35	0.38	0.40	0.43	0.45	0.47	0.50	0.52
30	0.17	0.23	0.28	0.33	0.37	0.41	0.45	0.49	0.53	0.56	0.60	0.63	0.66	0.70	0.73
35	0.23	0.31	0.37	0.44	0.49	0.55	0.60	0.65	0.70	0.75	0.79	0.84	0.88	0.93	0.97
40	0.30	0.39	0.48	0.56	0.63	0.70	0.77	0.83	0.90	0.96	1.02	1.07	1.13	1.18	1.24
45	0.37	0.49	0.59	0.69	0.79	0.87	0.96	1.04	1.12	1.19	1.26	1.34	1.41	1.47	1.54
50	0.45	0.59	0.72	0.84	0.96	1.06	1.16	1.26	1.36	1.45	1.54	1.62	1.71	1.79	1.87
55	0.54	0.71	0.86	1.01	1.14	1.27	1.39	1.51	1.62	1.73	1.83	1.94	2.04	2.14	2.24
60	0.63	0.83	1.01	1.18	1.34	1.49	1.63	1.77	1.90	2.03	2.16	2.28	2.40	2.51	2.63
65	0.73	0.97	1.18	1.37	1.55	1.73	1.89	2.05	2.21	2.36	2.50	2.64	2.78	2.91	3.05
70	0.84	1.11	1.35	1.57	1.78	1.98	2.17	2.35	2.53	2.70	2.87	3.03	3.19	3.34	3.50
75	0.95	1.26	1.53	1.79	2.03	2.25	2.47	2.68	2.88	3.07	3.26	3.44	3.62	3.80	3.97
60	1.07	1.42	1.73	2.01	2.28	2.54	2.78	3.02	3.24	3.46	3.67	3.68	4.08	4.28	4.58
65	1.20	1.59	1.93	2.25	2.55	2.64	3.11	3.37	3.63	3.87	4.11	4.34	4.57	4.79	5.01
90	1.33	1.77	2.15	2.51	2.84	3.16	3.46	3.75	4.03	4.31	4.57	4.83	5.08	5.33	5.57
95	1.48	1.95	2.36	2.77	3.14	3.49	3.62	4.15	4.46	4.76	5.05	5.34	5.62	5.89	6.16
100	1.62	2.14	2.61	3.05	3.45	3.84	4.21	4.56	4.90	5.23	5.56	5.87	6.18	6.46	6.77
105	1.78	2.35	2.86	3.33	3.78	4.20	4.60	4.99	5.37	5.73	6.08	6.43	6.76	7.09	7.41
110	1.94	2.56	3.12	3.63	4.12	4.58	5.02	5.44	5.65	6.24	6.63	7.00	7.37	7.73	8.08

'Block-outlined area indicates general extent of basic data.

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Table 2.— *Cubic-meter merchantable stem volume (inside bark) of ucar*

D.b.h.	Merchantable bole length (m)														
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CM	Cubic meters														
20	0.07	0.09	0.11	0.13	0.14	0.16	0.17	0.19	0.20	0.22	0.23	0.24	0.25	0.28	0.28
25	0.11	0.14	0.17	0.20	0.22	0.24	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.42
30	0.15	0.20	0.24	0.28	0.31	0.35	0.38	0.41	0.44	0.47	0.50	0.52	0.55	0.58	0.60
35	0.20	0.27	0.32	0.37	0.42	0.47	0.51	0.55	0.59	0.63	0.67	0.70	0.74	0.77	0.81
40	0.26	0.34	0.42	0.48	0.54	0.60	0.66	0.71	0.76	0.81	0.86	0.91	0.95	1.00	1.04
45	0.33	0.43	0.52	0.60	0.68	0.76	0.82	0.89	0.96	1.02	1.08	1.14	1.19	1.25	1.30
50	0.40	0.53	0.64	0.74	0.63	0.92	1.01	1.09	1.17	1.25	1.32	1.39	1.46	1.52	1.60
55	0.46	0.63	0.77	0.89	1.00	1.11	1.21	1.31	1.40	1.49	1.58	1.67	1.75	1.83	1.91
60	0.57	0.75	0.90	1.05	1.18	1.31	1.43	1.55	1.66	1.76	1.87	1.97	2.07	2.17	2.26
65	0.67	0.87	1.05	1.22	1.38	1.53	1.67	1.80	1.93	2.06	2.18	2.30	2.41	2.52	2.64
70	0.77	1.00	1.22	1.41	1.69	1.76	1.92	2.08	2.23	2.37	2.51	2.65	2.78	2.91	3.04
75	0.88	1.15	1.39	1.81	1.81	2.01	2.19	2.37	2.54	2.71	2.87	3.02	3.17	3.32	3.47
80	0.99	1.30	1.57	1.62	2.05	2.27	2.48	2.68	2.87	3.06	3.24	3.42	3.59	3.76	3.92
85	1.11	1.46	1.78	2.04	2.30	2.55	2.79	3.01	3.23	3.44	3.64	3.84	4.03	4.22	4.40
90	1.24	1.63	1.97	2.28	2.57	2.84	3.11	3.36	3.60	3.83	4.06	4.28	4.50	4.71	4.91
95	1.38	1.80	2.18	2.53	2.85	3.15	3.45	3.72	3.99	4.25	4.50	4.75	4.99	5.22	5.45
100	1.52	1.99	2.40	2.79	3.14	3.48	3.80	4.11	4.41	4.69	4.97	5.24	5.50	5.76	6.01
105	1.67	2.18	2.64	3.06	3.45	3.82	4.17	4.51	4.84	5.15	5.46	5.75	6.04	6.32	6.60
110	1.83	2.39	2.89	3.34	3.77	4.18	4.56	4.93	5.29	5.63	5.96	6.29	6.60	6.91	7.21

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